

Section 904. ASPHALTIC MATERIALS

904.01 General Requirements. The Asphalt binder listed in Table 904-1 and the emulsified asphalts listed in Tables 904-3 and 904-4 are governed by the certification program described in the *Materials Quality Assurance Procedures Manual*. All materials listed in Tables 904-1 through 904-4 can be used on MDOT projects, provided they are tested and approved for use according to MDOT procedures.

When test results for the requirements in Tables 904-1 through 904-4 deviate from the specified range, the Contractor and Supplier will be notified to take corrective action to bring the material into the specified range.

904.02 Application Temperatures. Asphaltic materials shall be applied within the temperature ranges shown in Table 904-5.

904.03 Specific Requirements.

A. Asphalt Binder. Asphalt binder shall meet the requirements in Table 904-1.

The asphalt binder shall be homogeneous, free from water, and shall not foam when heated to the maximum temperature in Table 904-5 for the material being used.

If an anti-foaming agent is used, it shall be a dimethyl polysiloxane type silicone material, preferably 1000 centistoke viscosity grade. Other types of anti-foaming agents, or the addition of amounts in excess of five parts per million, must be approved by the Engineer. The asphalt binder shall be thoroughly mixed by mechanical means after addition of the anti-foaming agent. The asphalt binder shall be further mechanically agitated while in storage at the asphalt plant.

Asphalt cement shall be prepared by the refining of crude petroleum by suitable methods, with or without the addition of modifiers. Used motor oil should not be used in the preparation of the asphalt cement.

Modifiers may be any organic material of suitable manufacture, used in virgin or recycled condition, and that is dissolved, dispersed or reacted in asphalt cement to enhance its performance.

The asphalt binder shall be at least 99.0 percent soluble as determined by AASHTO T44 or ASTM D5546.

This specification is not applicable for asphalt binders in which fibers or other discrete particles are larger than 250 um in size.

B. Cut-Back Asphalt. Cut-back asphalt shall meet the requirements in Table 904-2 and as specified herein.

All liquid asphalt shall be homogenous and shall not foam when heated to the required temperature for proper application. Unless otherwise specified, they shall be free from water.

Caution. The temperatures for use of cut-back asphalt, especially RC and MC asphaltic products (naphtha and kerosene cut-back asphalt), are near or above the flash points. When heated cutbacks are used, open flames must be kept away from pugmill enclosures, tank car domes, distributor tank openings and storage tank openings.

- C. **Emulsified Asphalt.** Emulsified asphalt shall meet the requirements in either Table 904-3 or Table 904-4.

Emulsified asphalt shall be made from base asphalt having a negative spot. It shall be homogeneous and shall show no separation of asphalt after thorough mixing, for a period of at least thirty days after delivery.

- D. **Polymer Modified Asphalt Cement for Overband Crackfill.** Type D certification must be provided by the Contractor for this material. The method for making the polymer modified asphalt cement will be the choice of the Contractor and/or supplier. The supplier shall provide a 3.2 pound sample in a hot melt box upon request of the Engineer. The polymer modified asphalt cement shall meet the requirements of ASTM D 5840 Table 1 for designation II-B with the following exceptions:

1. **Tests on Original Product.**

- a. Penetration at 25 °C, 100 g, 5 s, shall be 70 dmm minimum and 110 dmm maximum.
- b. An additional requirement for softening point by the ring-and-bell method, ASTM D 36 is added and shall be a minimum of 52 °C.

2. **Tests on Aged Residue.** The requirement for viscosity at 60 °C, 1 s^{-1} , maximum 8000 poise is deleted.

- E. **Polyester Fibers for Overband Crack Fill.** Type D certification must be provided by the Contractor for this material. The polyester fibers shall meet the following requirements:

Length	6.4 mm \pm 0.05 mm
Crimps, (ASTM D-3937)	None
Tensile strength, (ASTM D-2256)*	480 MPa minimum
Denier, (ASTM D-1577)*	3.0 to 6.0
Specific gravity	1.32 to 1.40
Melting temperature	245 °C minimum
Ignition temperature	540 °C minimum

*These data must be obtained prior to cutting the fibers.

Table 904-1 Performance Graded Asphalt Binder Specification

Performance Grade	PG 46			PG 52							PG 58				
	34	40	-46	-10	-16	-22	-28	-34	-40	-46	-16	-22	-28	-34	-40
Avg 7-day Max. Pavement Design Temp, °C (a)	<46			<52							<58				
Minimum Pavement Design Temp, °C (a)	>-34	>-40	>-46	>-10	>-16	>-22	>-28	>-34	>-40	>-46	>-16	>-22	>-28	>-34	>-40
Original Binder															
Flash Point Temp, T48: Min. °C	230														
Viscosity, ASTM D 4402: Max. 3 Pa•s, Test Temp, °C (b)	135														
Dynamic Shear, TP5: G*/sin Min. 1.00 kPa Test Temp at 10 rad/s, °C (c)(g)	46			52							58				
Rolling Thin Film Oven (T 240)															
Mass Loss, Max. Percent	1.00														
Dynamic Shear, TP5: G*/sin Min. 2.20 kPa Test Temp at 10 rad/s, °C (g)	46			52							58				
Pressure Aging Vessel Residue (PP1)															
PAV Aging Temp, °C (d)	90			90							100				
Dynamic Shear, TP5: G*/sin Max. 5000 kPa Test Temp at 10 rad/s, °C (g)	10	7	4	25	22	19	16	13	10	7	25	22	19	16	13
Physical Hardening (e)	Report														
Creep Stiffness, TP1: S, Max. 300 MPa, m-value, Min. 0.300 Test Temp at 60 s, °C (f)	-24	-30	-36	0	-6	-12	-18	-24	-30	-36	-6	-12	-18	-24	-30
Direct Tension, TP3: Fail. Strain,Min. 1.0% Test Temp at 1.0 mm/min, °C (f)	-24	-30	-36	0	-6	-12	-18	-24	-30	-36	-6	-12	-18	-24	-30

Table 904-1 Performance Graded Asphalt Binder Specification (Continued)

Performance Grade	PG 64						PG 70					
	10	16	-22	-28	-34	-40	>-10	-16	-22	-28	-34	-40
Avg 7-day Max. Pave Design Temp, °C (a)	<64						<70					
Minimum Pavement Design Temp, °C	>-10	>-16	>-22	>-28	>-34	>-40	>-10	>-16	>-22	>-28	>-34	>-40
Original Binder												
Flash Point Temp, T48: Min. °C	230											
Viscosity, ASTM D 4402: Max. 3 Pa•s, Test Temp, °C (b)	135											
Dynamic Shear, TP5: G*/sin ϕ Min. 1.00 kPa Test Temp at 10 rad/s, °C (c)(g)	64						70					
Rolling Thin Film Oven (T 240)												
Mass Loss, Max. Percent	1.00											
Dynamic Shear, TP5: G*/sin ϕ Min. 2.20 kPa Test Temp at 10 rad/s, °C (g)	64						70					
Pressure Aging Vessel Residue (PP1)												
PAV Aging Temp, °C (d)	100						100 (110)					
Dynamic Shear, TP5: G*/sin ϕ Max. 5000 kPa Test Temp at 10 rad/s, °C (g)	31	28	25	22	19	16	34	31	28	25	22	19
Physical Hardening (e)	Report											
Creep Stiffness, TP1: S, Max. 300 MPa, m-value, Min. 0.300 Test Temp at 60 s, °C (f)	0	-6	-12	-18	-24	-30	0	-6	-12	-18	-24	-30
Direct Tension, TP3: Fail. Strain, Min. 1.0% Test Temp at 1.0 mm/min, °C (f)	0	-6	-12	-18	-24	-30	0	-6	-12	-18	-24	-30

Table 904-1 Performance Graded Asphalt Binder Specification (Continued)

Performance Grade	PG 76					PG 82				
	-10	-16	-22	-28	-34	-10	-16	-22	28	34
Avg 7-day Max. Pave Design Temp, °C (a)	<76					<82				
Minimum Pavement Design Temp, °C	>-10	>-16	>-22	>-28	>-34	>-10	>-16	>-22	>-28	>-34
Original Binder										
Flash Point Temp, T48: Min. °C	230					135				
Viscosity, ASTM D 4402: Max. 3 Pa•s, Test Temp, °C (b)	76					82				
Dynamic Shear, TP5: G*/sin ϕ Min. 1.00 kPa Test Temp at 10 rad/s, °C (c)(g)	76					82				
Rolling Thin Film Oven (T 240)										
Mass Loss, Max. Percent	1.00					82				
Dynamic Shear, TP5: G*/sin ϕ Min. 2.20 kPa Test Temp at 10 rad/s, °C (g)	76					82				
Pressure Aging Vessel Residue (PP1)										
PAV Aging Temp, °C (d)	100 (110)					100 (110)				
Dynamic Shear, TP5: G*/sin ϕ Max. 5000 kPa Test Temp at 10 rad/s, °C (g)	37	34	31	28	22	40	37	34	31	28
Physical Hardening (e)	Report									
Creep Stiffness, TP1: S, Max. 300 MPa, m-value, Min. 0.300 Test Temp @ 60 s, °C (f)	0	-6	-12	-18	-24	0	-6	-12	-18	-24
Direct Tension, TP3: Fail. Strain, Min. 1.0% Test Temp @ 1.0 mm/min, °C (f)	0	-6	-12	-18	-24	0	-6	-12	-18	-24

a. Pavement temperatures are estimated from air temperatures using an algorithm contained in the Superpave software program, may be provided by the specifying agency, or by following the procedures as outlined in MP2 and PP28.

b. This requirement may be waived at the discretion of the specifying agency if the supplier warrants that the asphalt binder can be adequately pumped and mixed at temperatures that meet all applicable safety standards.

c. For quality control of unmodified asphalt cement production, measurement of the viscosity of the original asphalt cement may be used or supplement dynamic shear measurements of G*/sin ϕ at test temperatures where the asphalt is a Newtonian fluid. Any suitable standard means of viscosity measurement may be used, including capillary or rotational viscometer (AASHTO T 201 or T 202).

d. The PAV aging temperature is based on simulated climatic conditions and is one of three temperatures 90 °C, 100 °C or 110 °C. The PAV aging temperature is 100 °C for PG 58- and above, except in desert climates, where it is 110 °C.

e. Physical Hardening - TP 1 is performed on a set of asphalt beams according to Section 13.1, except the conditioning time is extended to 24 hrs \pm 10 minutes at 10 °C above the minimum performance temperature. The 24-hour stiffness and m-value are reported for information purposes only.

f. If the creep stiffness is below 300 MPa, the direct tension test is not required. If the creep stiffness is between 300 and 600 MPa, the direct tension failure strain requirement can be used in lieu of the creep stiffness requirement. The m-value requirement must be satisfied in both cases.

g. G*/sin ϕ high temperature stiffness and G*/sin ϕ intermediate temperature stiffness.

Table 904-2 Medium and Rapid Curing Cut-Back Asphalts

Tests	Requirements			
	MC-30(a)	MC-70(a)	MC-250	RC-250
Kinematic Viscosity, 60 °C, mm ² /s, ASTM D 2170	30 to 60	70 to 140	250 to 500	250 to 500
Flash Point, deg °C:				
Tag Open Cup, min, ASTM D 1310	37.8	37.8		26.7
Cleveland Open Cup, min, ASTM D 92			65.6	
Distillation Test, ASTM D 402:				
Distillate, % by Vol of Total Distillate to 360 °C:				
To 225 °C	25 max	20 max	10 max	35 min
To 260 °C	40-70	20-60	15-55	60 min
To 315.5 °C	75-93	65-90	60-87	80 min
Residue from Distillation to 360 °C, min	50	55	67	65
Tests on Residue from Distillation, ASTM D 402:				
Penetration at 25 °C, 100 g, 5 sec, ASTM D 5	120 to 250	120-250	120-250	80 to 120
Ductility at 25 °C, cm, min ASTM D 113 (b)	100	100	100	100
Solubility in Trichloroethylene, %, min, ASTM D 2042	99.5	99.5	99.5	99.5
Spot Test, AASHTO T 102 (c)	Neg.	Neg.	Neg.	Neg.
Section Number Reference		914		710, 914
<p>a. MC-70 grade shall be used during the period June 1 to September 1 and MC-30 grade shall be used at other times of the year, unless otherwise directed by the Engineer.</p> <p>b. If penetration of residue is more than 200 and its ductility at 25 °C is less than 100, the material will be acceptable if its ductility at 15.6 °C is more than 100.</p> <p>c. Utilizing a 35% Xylene - 65% Heptane solvent, aniline number : 30 °C ± 2 degrees.</p>				

Table 904-3 Anionic Emulsified Asphalts

Tests ASTM 244, Unless Otherwise Designated	Requirements							
	RS-1m	RS-2a	HFRS-2	HFRS-2M	MS-Op	MS-2h	MS-2s	SS-1h
Viscosity, Saybolt Furol, ASTM D 88:								
At 25 °C, sec	20-100							20-100
At 50 °C, sec		50-300	50-300	75-300	15-150	50-300	50-300	
Storage Stability Test, 24-hr, % Difference max	2	2	2	1	3	3	3	2
Demulsibility:								
35 ml 0.02 N CaCl ₂ , %	20-60	60 min	40 min					
50 ml 0.1 N CaCl ₂ , %								2 max
50 ml 0.02 N CaCl ₂ , %				50 min				
Sieve Test, % max	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Miscibility with Water (a)								Yes
Distillation to 260 °C, % by Weight: (b)				(d)				
Residue, Min	65	65	65	65	65	65	65	60
Oil Distillate, max	2	2	2	2	25	7	7	2
Tests on Distillation Residue:								
Penetration, 25 °C, 100 g, 5 sec, dmm, ASTM D 5	100-200	100-200	100-200	80-150	(c)	150-300	300 min	40-90
Float Test, sec, ASTM D 139:								
At 50 °C, max					200			
At 60 °C, min			1200	1200		1200	1200	
Ductility, 25 °C, cm, min, ASTM D 113	60	60	60		40(c)			40
Solubility in Trichloroethylene, % min, ASTM D 2042	97.5	97.5	97.5		97.5	97.5	97.5	97.5
Ash Content, %, max ASTM D 128	2	2	2	2	2	2	2	2
Specific Gravity, 25/25 °C, min. ASTM D 70	0.996	0.996	0.996					
Toughness/Tenacity, 25 °C, 50 cm/min., Nm, Mln., ASTM D-4 Proposal P243				4.5/3.5				
Elastic Recovery, 10 °C, % min., MTM 312				60%				
Section Number Reference	917	401		508	502		501	502,805, 917

a. No appreciable coagulation or visible separation in 2 hours.

b. The test for residue by distillation shall be modified in accordance with MTM 302.

c. The distillation residue shall cook (ASTM D 243) to 100 ± 15 penetration within 2 hours and have a ductility of 40 cm, minimum.

d. ASTM D 244, with modifications to include a 204 °C (± 6 °C) maximum temperature to be held for 15 minutes.

Table 904-4 Cationic Emulsified Asphalts

[illegible]

Table 904-5 Temperatures for Asphaltic Materials

Type of Asphalt	Designation	Temperature °F Distributor
Cut-Back Asphalts	RC-250	145 - 220
	MC-250	145 - 220
	MC-30	70 - 140
	MC-70	105 - 180
Emulsified Asphalts	RS-1m, SS-1h, CSSmM, CRS-1, CSS-1h, CSS-1hM,	85 - 135
	RS-2a, HFRS-2, HFRS-2M, MS-2h, MS-2s, CRS-2, CMS-2, CRS-2M	125 - 175
Asphalt Binder	All Grades (a) (except polymer modified binders)	350 Maximum Mixing Temperature
a. Mixing temperature for Polymer Modified Asphalt Binder will be specified by the modifier/binder producer.		